AD-A179 697 USING BAR CODES TO ENHANCE MAPS AND CHARTS(U) ARMY ENGINEER STUDIES CENTER FORT BELVOIR VA D R CALDWELL 1986 USAETL-R098 1/1

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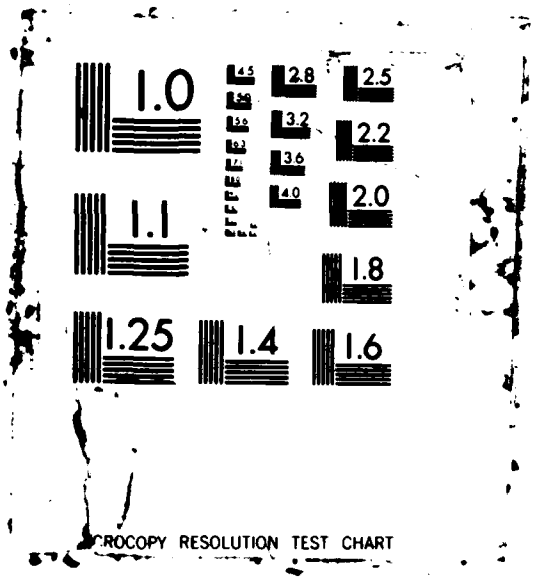
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Printed map and chart products may be linked to digital systems using a hybrid low technology/high technology map system. The system includes a paper map overprinted with machine-readable information, a reader to decode the information, and software to process the decoded data. Techniques for placing machine-readable data may be adopted from the automatic identification field. Bar code, optical character recognition (OCR), bit code, and magnetic stripe systems are all potentially applicable. The U.S. Army Engineer Topographic Laboratories have demonstrated the hybrid concept with a bar code-based system linking

a Defense Mapping Agency nautical chart with a digital version of the World Port Index.

USING BAR CODES TO ENHANCE MAPS AND CHARTS

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ABSTRACT

Printed map and chart products may be linked to digital systems using a hybrid low technology/high technology map system. The system includes a paper map overprinted with machine-readable information, a reader to decode the information, and software to process the decoded data. Techniques for placing machine-readable data may be adopted from the automatic identification field. Bar code, optical character recognition (OCR), bit code, and magnetic stripe systems are all potentially applicable. The U.S. Army Engineer Topographic Laboratories have demonstrated the hybrid concept with a bar code-based system linking a Defense Mapping Agency nautical chart with a digital version of the World Port Index.

INTRODUCTION

Maps and charts reflect the topical interests and technical expertise of the producers and users. Recently, the design of these products has been reviewed in an attempt to improve the readibility of the documents and streamline their development. Specifications are being changed to reflect the capabilities and limitations of automated production systems.

While the new maps and charts have a cleaner appearance and are easier to generate, they remain self-contained sources of geographic information, isolated from the ever increasing body of digital data. The purpose of this paper is to address the rift between printed and digital products and propose a method for integrating them. The solution lies in the hybrid low technology/high technology or enhanced map system. The low technology/high technology map system concept and development of a prototype system are discussed below.

HYBRID LOW TECHNOLOGY/HIGH TECHNOLOGY MAP SYSTEMS

The hybrid low technology/high technology map system includes three components: first, a traditional paper map or chart overprinted with machine-readable information; second, a low cost, portable reader to scan and decode the machine-readable codes; and third, a computer and software to process the decoded data. The system is low technology in its use of the printed map, but high technology with the addition of machine-readable codes. The map can be used as a standalone product or incorporated as an element of a digital system. The machine-readable information could contain identification codes, feature attributes, or data and programs. This information could be displayed, stored, or used as input to applications software. Two key features of the proposed system are its low cost and portability. Individual readers of machine-readable data generally cost less than $500.00 and are packaged in a hand-held form.

AUTOMATIC IDENTIFICATION TECHNOLOGIES

Machine-readable codes may be placed on maps using technologies adopted from the automatic identification field. This field encompasses a wide range of alternative approaches including optical mark recognition (OMR), bar code, optical character recognition (OCR), bit code, magnetic ink character recognition (MICR), magnetic stripe, and radio frequency (RF) systems.

For map and chart production, bar codes and optical character recognition approaches are suited for storing small amounts of alphanumeric text on the graphic. Bar code systems are more reliable, easier to use, and less expensive than OCR systems, but the codes are not human-readable. OCR systems are human-readable and generally consume less space than comparable bar codes.

Bit codes and magnetic stripes are most useful for storing larger amounts of data or software programs in the margins or on the back of the sheet. Bit codes, like the Cauzin Softstrip System, can store up to 5500 bytes of information in an eight inch strip. The strips may be printed on maps using standard reproduction processes and provide a non-magnetic alternative to floppy disks and tape for data distribution. Magnetic

stripes are the only form of automatic identification technology which can be updated without reprinting the graphic.

Bar code, optical character recognition, and bit code systems can all be implemented with current technology. Use of magnetic stripes would require the development of encoders to transfer data to stripes larger than the credit card size standard.

BAR CODE-BASED MAP SYSTEMS

Bar code-based systems are a logical starting point for the exploration of hybrid low technology/high technology map systems, because they are inexpensive, reliable, and easily integrated with existing computer systems. There are over one hundred different bar code symbologies, but the system of interest for military applications is Code 39. Use of this symbology is specified in MIL-STD-1189A, "Standard Department of Defense Bar Code Symbology."

Bar codes serve a variety of purposes on an enhanced map. The codes may contain feature identification or attribute codes, commands to drive applications software, or larger amounts of data and programs. If the bar code contains a feature identification code, the code may be used to link the map feature with a supplemental digital database. (See Figure 1) Use of a bar coded menu simplifies the users interaction with the system and provides a consistent interface with the computer. Scanning takes about ten minutes to learn and bar code-based systems can be used by non-typists as well as typists. Banks and Helmer have demonstrated that bar codes can be used to store data and programs. They developed a byte-oriented symbology capable of storing over 2000 bytes of information on a 10" X 7.5" page. However, bar codes are not generally recommended for storing larger amounts of information due to their low density of information and the requirement for hand scanning. Bit codes store more information and can be read faster.

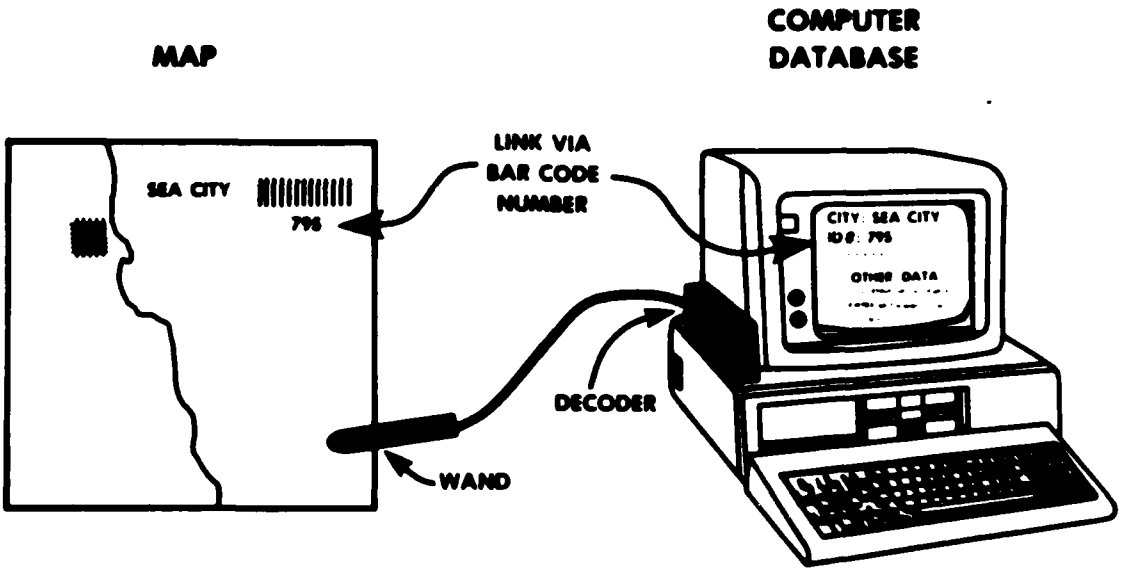

Figure 1. Linking Individual Map Features with a Digital Database

APPLICATION DEVELOPMENT: THE ENHANCED NAUTICAL CHART

A prototype hybrid low technology/high technology map system was developed to validate the concept. Hardware components included an IBM-compatible Kaypro PC, a Barcode Industries Inc. Model Barpen 40 TTL light pen with Model MR-200 Mindreader decoder, and a Cauzin Softstrip reader. The applications software was developed using dBase III Plus from Ashton-Tate.

The hardware and software were used to create an enhanced nautical chart system. The system linked a printed nautical chart with a digital version of the World Port Index. The World Port Index is a printed publication containing detailed information on references, harbor characteristics, entrance restrictions, loading facilities, supplies, and services for all major ports.

The basic nautical chart was modified with the addition of bar codes for the individual ports, a bar code-base menu, and a bit code database. Each port had a Code 39 bar code containing the World Port Index identification number for the port. (See Figure 2) Information on the ports was accessed from the applications program using the bar-code based menu. The

menu contained codes to load the program as well as select choices from the software menu. (See Figure 3) The actual database for the sheet was printed on the back using bit codes. (See Figure 4)

Use of the enhanced nautical chart is straightforward. Once the database is loaded, the user accesses the applications program by scanning the START PROGRAM option. The program asks the user to select the port of interests. (See Figure 5) The user scans the bar code of the port and the program asks the user to select the information to be displayed. (See Figure 6) The user scans the option number from the bar code-based menu and the information appears on the display. (See Figure 6)

The nautical chart is well suited for enhancement. It is a large format, low graphic density product which can accomodate the space consumptive bar codes. In addition, charts are supplemented by a variety of publications. These publications provide information on lights, tides, communications, and chart updates.

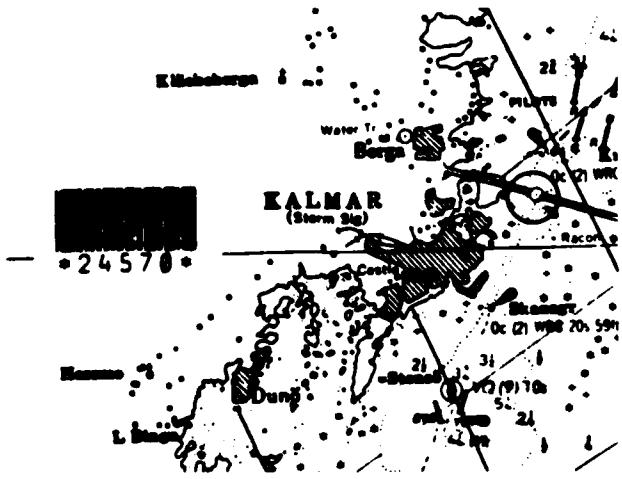

Figure 2. DMA Nautical Chart with Bar Code

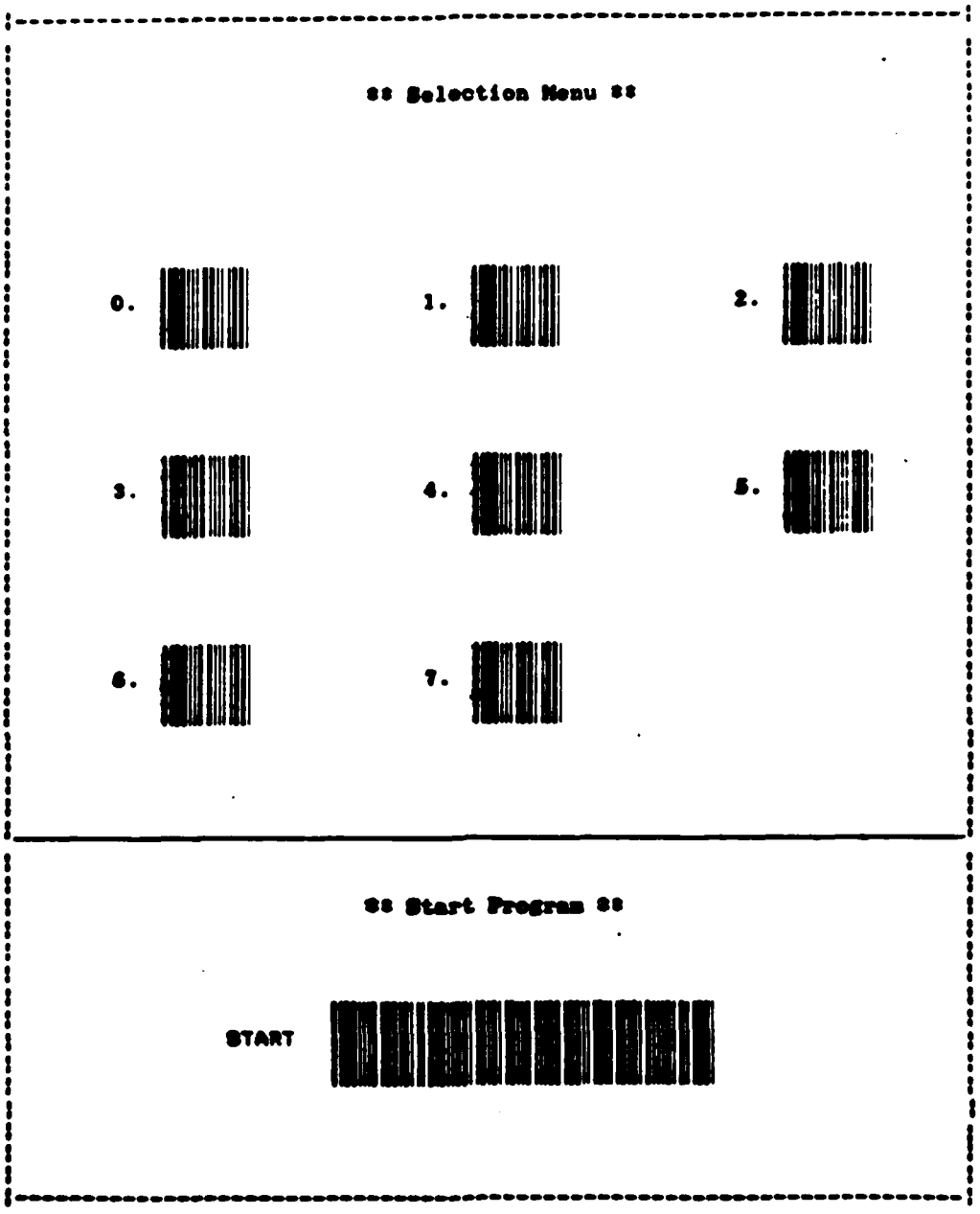

Figure 3. Bar Code-Based Menu

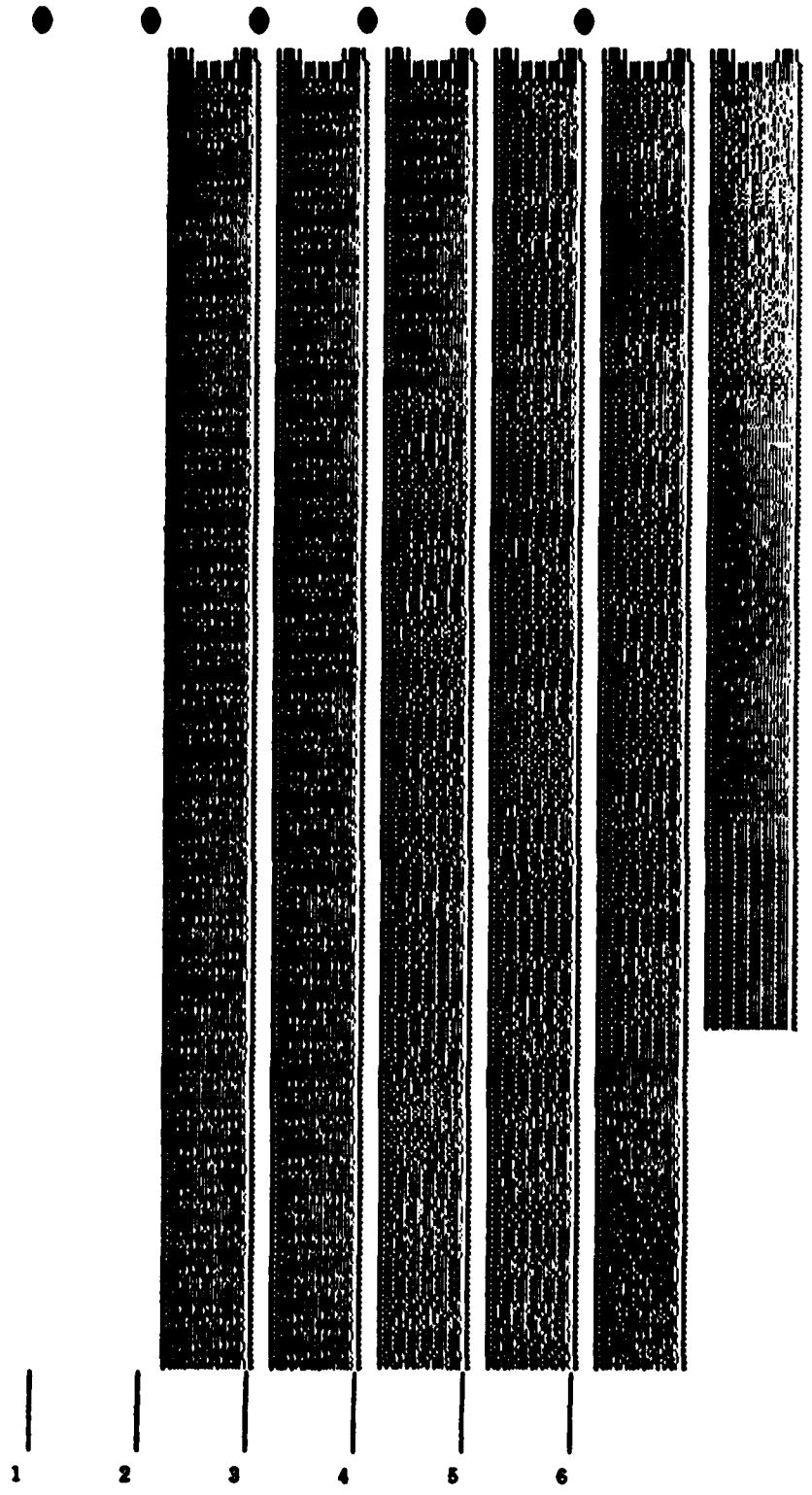

Figure 4. Database Stored in Bit Code Form

PORT SELECTION

** Scan the Bar Code of the Port of Interest **

Scan Port Code: 24690

Figure 5. Selection of Port

OPTION SELECTION

** Select the Option of Choice **

1. Basic Information
2. Entrance Restrictions and Depths
3. Supplies and Services
4. Communications
5. Pilotage and Tugs
6. Loading, Cranes, and Lifts
7. Quarantine and Other

0. QUIT

Select Option: 1

Figure 6. Selection of Display Option

```
                    BASIC INFORMATION
                    ================

Name:   OSKARSHAMN                          Country:   SW

                Reference Number:   24690

                ** Location **

        Latitude:   5716N          Longitude:   01627E

                ** Reference Material **

    Sailing Directions:   194      Best Chart:   44120

                ** Harbor Information **

Harbor Size:   SMALL              Maximum Size Vessel:   > 500' LENGTH
Harbor Type:   COASTAL NATURAL    Good Holding Ground:   YES
Shelter    :   GOOD               Turning Area       :   NO INFORMATION

Previous Screen-1, Next Screen-2, Select Option-3, New Port-4
Quit-0. Scan Code of Choice:        2
```

Figure 7. World Port Index Data Display

CONCLUSIONS

The enhanced nautical chart demonstrates the hybrid low technology/high technology map system concept. Paper map and chart products can and should be linked to digital systems. This maintains the advantages of the printed product while utilizing the ever increasing potential of computers. Bar code and optical character recognition systems are useful for placing small amounts of machine-readable text within the map area, while bit codes and magnetic stripes are well suited for storing larger amounts of data and programs. Bar code-based systems are the logical starting point for the development of enhanced mapping systems. They are reliable, inexpensive, simple to learn, and easily implemented.

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